**Science Reading Questions: “The Structure of the Atom”**

1. Democritus’s ideas were rejected by other philosophers of his time because he could not answer or explain what held atoms together as he did not know. Also his ideas did not agree with the ideas of other philosophers of the time.
2. An atom is the smallest building block of everything around us
3. Dalton believed that atoms were indivisible; however, modern atomic theory shows that atoms can be divided into several subatomic particles. He also believed that all atoms of any element have identical properties, but modern theory shows that atoms of an element can have different masses.
4. Democritus reached his theory through thinking about the world around him and matter and wondering what it was all made up of, eventually he came to the conclusion that all matter was made u of tiny particles called “atomos.” Dalton reached his theory through looking at Democritus’s theory and conducting research. He performed various experiments and studied many chemical reactions, carefully making observations and taking measurements while he did so.

Democritus’s ideas hampered the acceptance of his theory because his ideas were too far ahead for his time and he was not able to experiment in the way that Dalton could as science was not anywhere near as advanced as it was in Dalton’s time.

1. Democritus and Dalton had rather similar theories. They both believed that everything was made u of atoms and that changes in matter were the result of a change in the grouping of atoms. They also believed that atoms could not be destroyed or divided. However their theories are also different in a few ways. Democritus believed that there were different kinds of atoms, while Dalton believed that all atoms of a given element are identical and different from those of any other elements. Dalton also believed that all matter was made up of extremely small particles called atoms, whereas Democritus believed that all matter was made of empty space through which atoms moved.
2. The experiments which led to the conclusion of electrons being negatively charged involved the use of cathode ray tubes and magnets. When the experiments were carried out scientists noticed that the cathode ray was deflected, or pulled toward the positive side of the magnet which lead to the conclusion that the particles had a negative charge.
3. The typical atom is composed of three subatomic particles. There is a nucleus (the centre) which contains protons (positively charged) and neutrons (neutral charge). Around this, there are orbitals where the electrons (negative charge) are located.

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| --- | --- | --- |
| **Subatomic Particle** | **Charge** | **Mass (amu)** |
| Proton | 0 | 1 (1.007 276) |
| Neutron | + | 1 (1.008 665) |
| Electron | - | 1/1840 (0.000 549) |

1. Thomson’s plum pudding model suggested that electrons were distributed throughout a uniform positive charge, whereas Rutherford’s nuclear atomic model suggested that there was no uniform positive charge. Instead it suggested that electrons moved rapidly through an empty space surrounding the nucleus but were held within the atom by the positive charge of the nucleus and the attraction it created between the electrons and protons.
2. Timeline drawn on piece of paper.
3. 1. Boron = Protons -5, Electrons-5, Neutrons-6
   2. Platinum = Protons -78, Electrons-78, Neutrons-117
   3. Radon= Protons -86, Electrons-86, Neutrons-136
   4. Magnesium= Protons -12, Electrons-12, Neutrons-12
4. Dysprosium
5. Silicon

b. Calcium= Protons -20, Electrons-20, Neutrons-26

c. Oxygen= Protons -8, Electrons-8, Neutrons-9

d. Iron= Protons -26, Electrons-26, Neutrons-31

e. Zinc= Protons -30, Electrons-30, Neutrons-34

f. Mercury = Protons -80, Electrons-80, Neutrons-124

15. Boron-10 mass contribution = (10.013 amu)(0.198)= 1.982574

Boron-11 mass contribution = (11.009 amu)(0.802)= 8.829218

Atomic mass of Boron= 1.982574 + 8.829218 = 10.811792 amu

16. Seeing as the mass of Helium is 4.003 then it is more likely that Helium-4 is more abundant, if not then the average mass would have been brought down by a large number of Helium-3s and the average mass would have been 3 and not 4. Therefore, Helium-4 is more abundant.

17. Magnesium-23 mass contribution = (23.985 amu)(0.7899) = 18.9457515

Magnesium-24 mass contribution = (24.986 amu)(0.1000) = 2.4986

Magnesium-25 mass contribution = (25.982 amu)(0.1101) = 2.8606182

Atomic mass Magnesium = 18.9457515 + 2.4986 + 2.8606182 = 24.3049697

18. The number of protons identifies an atom as that of a particular element. The atomic number shows the number of protons present in the atom of a particular element.

19. An isotope is an atom that contains the same number of protons but has a different number of protons than the most abundant atom of that element. An example of this is potassium which has three isotopes; in one type of potassium there are 20 neutrons which is the most commonly found one (most abundant). Then there are other types of potassium with 21 neutrons and 22 neutrons.

20. Isotopes affect the mass of an element as the mass is an average of the isotopes and it is not usually a whole number because the mass of protons and neutrons are just a little bit more than 1 amu the values are slightly different which leads to decimals being used to calculate the mass more accurately.

21. Nitrogen-14 is more abundant in nature because the average mass is 14.007 and if Nitrogen-15 were more abundant the average mass would have to be higher than 14.007 and closer to or above 15 amu.

22. To calculate the average atomic mass you first need to find the mass contribution of each isotope. This is done by multiplying the atomic mass units by the abundance %. After each of the atomic mass contributions have been found for each isotope they are added together and the sum is the average atomic mass.

Ex. For Boron:

Boron-10

Mass= 10.013 amu

Abundance= 19.8% = 0.198

Boron-11

Mass= 11.009 amu

Abundance= 80.2% = 0.802

Boron-10 mass contribution = (10.013 amu)(0.198)= 1.982574

Boron-11 mass contribution = (11.009 amu)(0.802)= 8.829218

Atomic mass of Boron= 1.982574 + 8.829218 = 10.811792 amu